International Journal of Surgery 11 (2013) 301–304

Contents lists available at SciVerse ScienceDirect

International Journal of Surgery

journal homepage: www.theijs.com

Original research

# Incidence of right-sided colonic tumors (non-appendiceal) in patient's ≥40 years of age presenting with features of acute appendicitis

Suhail Aslam Khan*, Haseeb Anwar Khokhar, A.R.H. Nasr, Eleanor Carton

*Department of Colorectal Surgery, Our Lady of Lourdes Hospital, Drogheda Co. Louth, Ireland*

ARTICLE INFO

*Article history:*
Received 13 January 2013
Received in revised form
31 January 2013
Accepted 4 February 2013
Available online 14 February 2013

*Keywords:*
Appendicitis
Cecal tumors
CT scan
U/S and right colonic tumors

ABSTRACT

*Introduction:* Non-appendiceal tumors can mimic and present with clinical features of acute appendicitis in patients of age 40 years or above. The aim of this prospective study is to investigate the incidence of right-sided (non-appendiceal) colonic tumors in patients presenting with clinical features of acute appendicitis.

*Methods:* A prospective data analysis of 1662 patients using appendectomy database was performed from 2005 to 2011. Patients above age 40 years or older were included. Patients were compared for demographic data, clinical presentation, radiological findings, operative technique & findings, histo-pathological findings and postoperative complications. The primary outcome was incidence of right-sided colonic (non-appendiceal) tumors presenting with features of acute appendicitis. Secondary outcomes measured were, role of diagnostic radiology, negative appendectomy rate, length of stay and changing trends in operative techniques.

*Results:* From 1662 patients initially reviewed, only 179 patients (10.77%) age 40 years or above mean (56 ± 11.75), median 54 (40–89), with clinical features of acute appendicitis were included in the final analysis. F:M ratio was (1:1.06). CT scan showed in only 1 patient (1.25%, OR = 0.806, $p = 0.695$), suspicion of cecal tumor and underwent right hemicolectomy. Histological examination of specimen showed, 2 patients (1.11%, OR = 1.10, $p = 0.47$) had primary appendiceal tumors, in which one patient was histologically reported as appendiceal mucocele (mucinous cystadenoma with low-grade dysplasia), while the other one had appendeceal carcinoid (Goblet cell carcinoid). In the other tumor group one patient had metastatic involvement of appendix from ovarian tumor. The time to appendectomy in radiological group was delayed by (9.2 ± 3.7 h). 131 (73.1%) had laparoscopic while 48 (26.81%) underwent open appendectomy. The negative appendectomy rate was (1.12%) and 30 days complication rate was (11.73%, $p = 0.27$). Mean length of stay was 3.54 ± 2.1 days.

*Conclusion:* Right-sided colonic (cecal) tumors rarely present with features of acute appendicitis. Only those patients with atypical presentation and findings should have pre-operative radiological evaluation.



## 1. Introduction

Appendicitis remains the most common acute surgical condition of the abdomen.[1,2] The lifetime incidence is approximately 12 percent in men and 25 percent in women.[3] Yet, it is difficult to diagnose based solely on the patient's medical history, physical condition and laboratory findings.[1,4] Gastrointestinal and urogenital disorders are appendicitis mimicking conditions.[5]

Historically, classic physical findings such as pain at McBurney's point or the other clinical signs such as Psoas sign have been used to make the diagnosis, though the discriminative power of classic clinical and laboratory findings remains low.[6,7] Pathologically, obstruction of the appendiceal lumen is the usual cause of acute appendicitis.[9] However, in elderly patients it may also be due to a neoplasm, and appendicitis can be its first manifestation and these tumoral lesions may be appendiceal, or cecal in origin.[8–10]

Imaging allows an objective confirmation of the diagnosis.[6] The two most common modalities in use are abdominal helical computed tomography (CT) and abdominal ultrasound (US) with sensitivity ranging from 77 to 99%.[6–8] We know that, only about 0.5–1.0% of all cases of appendicitis are caused by appendiceal tumors confirmed mainly on histology.[4,15] But at the same time

* Corresponding author.
*E-mail addresses:* tahirkheli73@gmail.com (S.A. Khan), drheebeez@gmail.com (H.A. Khokhar), arhnasr@hotmail.com (A.R.H. Nasr), elcarton100@gmail.com (E. Carton).

1743-9191/$ – see front matter © 2013 Surgical Associates Ltd. Published by Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ijsu.2013.02.004

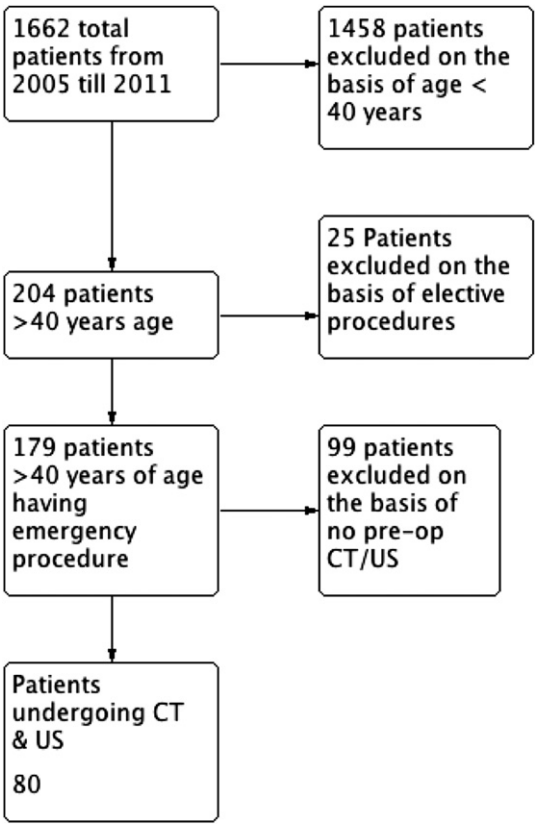


**Fig. 1.** Study flow diagram.

radiological investigations like U/S and CT scan are increasingly used as a tool to exclude right-sided (non-appendiceal) colonic tumors on emergency admissions with clinical features of acute appendicitis especially in patients that are 40 years or above. The aim of this prospective study is to investigate the incidence of right-sided (non-appendiceal) colonic tumors in patients presenting with clinical features of acute appendicitis.

## 2. Materials and methods

The present study was designed as a prospective, observational study in a single institute between January 1, 2005 and September 30, 2011. A total of 1662 patients were followed on for 30 days complication with clinical diagnosis of acute appendicitis. Patients were excluded using exclusion criteria if there age less than 40 years of age, those who underwent elective appendectomy and extended procedures such as hemi-colectomy of right colon on the elective list (Fig. 1: Flow diagram).

Data from hospital database as "appendicular diary" was reviewed on the basis of demography, clinical presentation, radiological investigations ordered, radiological interventions needed, operative reports, postoperative complications and histo-pathological reports. On the basis of above tumors were divided into, primary appendiceal tumors and others such as cecal or metastatic (Fig. 2 & Table 1).

Data was analyzed using the statistical software SPSS version 16. Data was expressed as numbers (%) and mean (standard deviation). The results were analyzed using the Fisher's exact test for discrete data and student *t*-test for continuous numeric data. Statistical significance was accepted at the *p* value being less than 0.05.

## 3. Results

From 1662 patients reviewed over 5 years from appendectomy database, 1458 patients (87.36%) were excluded because of age less than 40 years, and only 179 patients (10.77%) were included in the final analysis (Fig. 1: study flow diagram). The mean age was 56 ± 11.75, median 54 (40–89). Female to male ratio was (1:1.06). Total 80 (44.69%) patients out of 179 patients underwent radiological examination in the form of CT or Ultrasound abdomen (Fig. 2 & Table 1).

Out of the 80 patients investigated radiologically, CT scan showed in only 1 patient (1.25%, OR = 0.806, $p = 0.695$), suspicion of cecal tumor and underwent right hemicolectomy. Histological examination of specimens showed, out of total 179 patients above age of 40 years, 2 patients (1.11%, OR = 1.10, $p = 0.47$) had primary appendiceal tumors, in which one patient was histologically reported as appendiceal mucocele (mucinous cystadenoma with low-grade dysplasia), while the other one had appendeceal carcinoid (Goblet cell carcinoid). In the other tumor group one patient had metastatic involvement of appendix from ovarian tumor (Table 2).

In non-radiological group of patients diagnosed with acute appendicitis, which were 99 patients from total of 179, only two patients had diagnostic follow up colonoscopy within 6 months of their appendicectomy but no cecal pathology found in this group of patients on colonoscopy. In long term follow up (from 6 months to 5 years) of this group of patients showed, 9 patients had colonoscopy arranged for different indications and 1 patient was diagnosed as sigmoid while other one as rectal cancer which shows that they were not the cause of their earlier presentation.

The negative appendectomy rate was 1.12%. Mean length of stay was (3.54 ± 2.1 days). The time to appendectomy in radiological group was delayed by (9.2 ± 3.7 h), related to the time of their presentations to emergency departments (83% of radiological group presented in after hours). 30 days complication rate was (11.73%, $p = 0.27$) (Table 3).

## 4. Discussion

Since the time of Fitz[11] in 1886, surgery has been the standard treatment for acute appendicitis. The classical presentation of

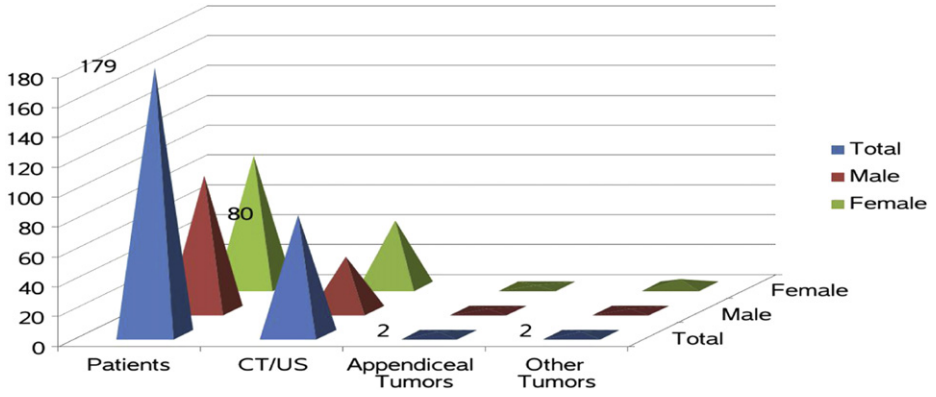


**Fig. 2.** Showing total numbers of patient; male to female ratio; type of radiological investigation and type of tumor.

**Table 1**
Showing demographic data; radiological investigation; type of procedure and 30 days complication rate.

| Pts ≥40 y | Mean (age) | Female:Male | CT/US | OA | LA | Complications (30 days) |
|---|---|---|---|---|---|---|
| 179 (10.77%) | 56 ± 11.75 | 1:1.06 | 80 (44.69%) | 48 (26.81%) | 131 (73.1%) | 11.73% |

**Table 2**
Showing histological diagnosis of specimen.

| Patients | Appendicitis | Missing histology | Normal | Cecal tumor | Appendicular tumors | Others | Total |
|---|---|---|---|---|---|---|---|
| Male | 89 | 0 | 1 | 1 | 1 | 0 | 92 |
| Female | 81 | 2 | 1 | 0 | 1 | 2 | 87 |
| **Total** | **170** | **2** | **4** | **1** | **2** | **2** | **179** |

appendicitis, central abdominal pain that localizes to the RIF with vomiting and a tachycardia with RIF tenderness on clinical exam, is not always present, coupled with the broad differential diagnosis of RIF pain makes the diagnosis challenging on a frequent basis. The overall diagnostic accuracy achieved by traditional history, physical examination, and laboratory tests is approximately 80 percent, and the ease and accuracy of diagnosis varies by the patient's sex and age, and is more difficult in women of childbearing age, children, and elderly persons.[9–13]

In most cases, obstruction of the appendiceal lumen is the cause of acute appendicitis. However, in elderly patients neoplasm's can cause obstruction of the appendiceal lumen and subsequently presents as acute appendicitis. This association of carcinoma of the cecum with appendicitis was first reported in 1906 by Sheers.[14] There are 3 main mechanisms that may lead to obstruction of the appendiceal lumen by a tumor, (i) tumor in the immediate proximity to the appendix; (ii) inflammatory changes by the carcinoma of the cecum, resulting in occlusion of the appendix; or (iii) tumor of the colon causing back pressure on the cecum resulting in obstruction of the appendix.[9,12–17]

The reported rate of association of carcinoma of the cecum with appendicitis in the available literature is very low. A review looking into the causes of appendicitis in 10,181 patients found that, the incidence of obstructing cecal cancer as a cause of acute appendicitis was only 0.8% in elderly patients.[15] Similarly, a 20-year retrospective review by Bizer in 1993,[16] reported only 1.8% of patients aged 65 years or older presenting with signs and symptoms of acute appendicitis had an underlying carcinoma of the cecum.[6]

Despite this low reported incidence of carcinoma of the cecum associated with appendicitis, radiological investigations like U/S and CT scan are increasingly used as a tool to exclude right-sided malignant tumors on emergency admissions especially in patients that are 40 years or above.[1–3,7,8,10]

Ultrasound (US) with graded compression has a sensitivity and specificity of 84.7% and 92.1%, respectively.[7] On the other hand computed tomography (CT) has a reported accuracy of 95–100% for acute appendicitis, but only has (54%) accuracy for identifying cecal tumors.[1–7] This would suggest that one would miss every second cecal tumor causing appendicitis. The radiological signs of appendicitis are appendiceal dilatation and peri-appendiceal fluid or stranding, but such findings can also be seen with mucocele of the appendix, peri-appendicitis, and other inflammatory or neoplastic processes involving the appendix.[8]

**Table 3**
30-day complication rate.

| 30 Days complications = 21 (11.73%) | |
|---|---|
| Wound infection | 3 |
| Bleeding | 2 |
| Abscess/collection | 6 |
| Visceral injury | 1 |
| Other | 9 |

In this study, we identified all patients >40 years with a clinical diagnosis of appendicitis. The diagnosis was based on history, clinical examination and laboratory investigations. Where diagnosis was not confirmed clinically radiological investigations were used (Table 1). All patients that went on to have an US or CT to exclude a malignancy were identified. Intraoperative findings were noted and all patients undergoing appendectomy had histological examination of their specimen (Table 2). Patients were discharged and followed up in clinic on an as required basis for any complications (Table 3).

The incidence of colonic tumors in our study was 0.55% which were comparatively lower than in literature as reported to be 1.76% in the study by Loong et al.[15] This showed that not only did colonic tumors present rarely with acute appendicitis at the same time the other pathologies like carcinoids, appendiceal tumors were not identified on CT or U/S which are not the investigations of choice for diagnosing these pathologies.

We also presented a trend analysis in our results that showed the maximum cases were performed laparoscopically (Table 1) with a conversion rate of 2.75%. The complication rate stood at 11.73% (Table 3), which is comparable to the complication rate of 10.87% by Ho Jun Lee.[18] 30 days postoperative complication analysis showed (Table 3), that postoperative abscess/collection was the most common complication in laparoscopic group. In those who underwent open appendicectomy, wound infection was most common followed by paralytic ileus (4), pulmonary (3) and cardiovascular complications (2).

Our study also has a number of limitations. First, the sample size was relatively small (179) and the fact that we only included patients that underwent radiological investigations, we are not sure that how many in the group of patients that did not had radiological investigations pre-operatively later on diagnosed with cecal lesions. Second, in (25) patients U/S was used which is not the modality of choice for diagnosing colonic/appendiceal tumors. Thirdly, as with any other study, missing charts and data is always a possibility but this was minimal as documentation was complete and only 2 histology reports were not found (Table 3) but included in final analysis as intention to treat.

Our results should also be interpreted carefully, particularly in a high-risk group such as those with a strong family history of germ line mutations like (HNPCC) which carries lifetime risk of colonic cancers of 70–80%. In these cases knowledge and use of criteria's such as Amsterdam's criteria should be utilized in identifying high-risk candidates for molecular genetic testing.[19]

However despite these limitations, our study is unique as, to our knowledge, this is the lowest reported incidence of right sided colonic (cecal) tumors in patients of age 40 years or older presenting with signs and symptoms of acute appendicitis. Thus looking at our data, no extra benefit seemed to have been obtained from performing radiologic tests pre-operatively and it is therefore worrying to observe an increasing trend in using radiologic investigations for the diagnosis of appendicitis for the past 11 years.[1–8]Possible reasons for this over-reliance on radiological investigations may be due to ease of access to radiological investigations, fear of misdiagnosis or loss of diagnostic skills. We are not sure if this is because of the ease of ordering radiologic tests

these days or for the fear of misdiagnosis of appendicitis or not trusting ones clinical acumen.

In conclusion, Right-sided colonic (cecal) tumors rarely present with features of acute appendicitis. Only those patients who fulfill criteria for high-risk group of colorectal carcinoma requires pre-operative radiological evaluation and other groups could possibly be followed up postoperatively with diagnostic modalities such as colonoscopy.

*Ethical approval*

Not applicable.

*Funding*

This study was not supported by any grant.

*Author contribution*

SAK contributed for the study design, data collection, data analysis and writing. SAK is the guarantor of submission.

HAK contributed for the study design, data analysis and proof read and writing.

BA contributed for the study design, data analysis and proof read.

ARHN contributed for the study design, data analysis and proof read.

EC contributed for the study design, data analysis and proof read.

*Conflict of interest*

All the authors had no conflict of interest.

## References

1. Lee SL, Ho HS. Ultrasonography and computed tomography in suspected acute appendicitis. *Semin Ultrasound CT MR* 2003 Apr;**24**(2):69–73.
2. Andre JB, Sebastian VA, Ruchman RM, et al. CT and appendicitis: evaluation of correlation between CT diagnosis and pathological diagnosis. *Postgrad Med J* 2008;**84**:321–4.
3. Jerry L, Dusing Reginald W, Wendell Y, Jared D. Imaging for suspected appendicitis. *Am Fam Physician* 2005;**71**:71–8.
4. Ron S, Shai E, Eran S, Moshe ZP, Douglas BZ. Appendiceal carcinoid at a large tertiary center: pathologic findings and long-term follow-up evaluation. *Am J Surg* 2011;**201**:805–8.
5. Gaitini D. Imaging acute appendicitis: state of the art. *J Clin Imaging Sci* 2011;**1**:49.
6. Reich B, Zalut T, Weiner SG. An international evaluation of ultrasound vs. computed tomography in the diagnosis of appendicitis. *Int J Emerg Med* 2011;**4**:68.
7. Randen AV, Bipat S, Zwinderman AH, Ubbink DT, Stoker J, Boermeester MA. Acute appendicitis: meta-analysis of diagnostic performance of CT and graded compression US related to prevalence of disease. *Radiology* 2008;**249**.
8. Watchorn RE, Poder L, Wang ZJ, Yeh BM, Webb EM, Coakley FV. Computed tomography findings mimicking appendicitis as a manifestation of colorectal cancer. *Clin Imaging* 2009;**33**(6):430–2.
9. Eriguchi N, Matsunaga A, Futamata Y, Tayama K, Harada H, Tanaka A, et al. Appendicitis caused by caecal carcinoma: report of a case. *Kurume Med J* 2002;**49**:217–9.
10. Pickhardt PJ, Levy AD, Rohrmann CA, Kende AI. Primary neoplasms of the appendix: radiologic spectrum of disease with pathologic correlation. *Radiographics* 2003;**23**:645–62.
11. Fitz RH. Perforating inflammation of the vermiform appendix with special reference to its early diagnosis and treatment. *Am J Med Sci* 1886;**92**:321–46.
12. Wangensteen OH, Bowers WF. Significance of the obstructive factor in the genesis of acute appendicitis. *Arch Surg* 1937;**34**(3):496–526.
13. Pieper R, Kager L, Tidefeldt U. Obstruction of appendix vermiformis causing acute appendicitis. On of the most common causes of this is an acute viral infection which causes lymphoid hyperplasia and therefore obstruction. An experimental study in the rabbit. *Acta Chir Scand* 1982;**148**(1):63–72.
14. Burt CAV. Carcinoma of the caecum complicated by appendicitis or para-caecal abcesses. *Surg Gynecol Obstet* 1949;**88**:501–8.
15. Lai HW, Loong CC, Tai LC, Wu CW, Lui WY. Incidence and odds ratio of appendicitis as first manifestation of CRC: discussion. *J Gastroenterol Hepatol* 2006;**21**(11):1693–6.
16. Bizer LS. Acute appendicitis is rarely the initial presentation of cecal cancer in the elderly patient. *J Surg Oncol* 1993;**54**:45–6.
17. Todd RD, Sarosi GA, Nwariaku F, Anthony T. Incidence and predictors of appendiceal tumors in elderly males presenting with signs and symptoms of acute appendicitis. *Am J Surg* 2004;**188**:500–4.
18. Lee HJ, Park YH, Kim JI, Choi PW, Park JH, Heo TG, et al. Comparison of clinical outcomes and hospital cost between open appendectomy and laparoscopic appendectomy. *J Korean Surg Soc* 2011;**81**:321–5.
19. Stoffel Elena M, Mercado Rowena C, Kohlmann Wendy, Ford Beth, Grover Shilpa, Conrad Peggy, et al. Prevalence and predictors of appropriate colorectal cancer surveillance in lynch syndrome. *Am J Gastroenterol* 2010 August;**105**(8):1851–60.